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Original/*Obesidad*

Nutritional and metabolic assessment in overweight patients with and without hyperprolactinemia caused by prolactinoma

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Abstract

Introduction: **prolactinomas are pituitary adenomas that express and secrete prolactin. These patients are overweight and the mechanisms are being studied.**

Goals: **assess nutritional and metabolic status of overweight patients with and without hyperprolactinemia caused by prolactinoma and compare them.**

Materials and methods: **cross-sectional study, patients with body mass index (BMI) ≥ 25 kg/m² with and without prolactinoma: 1) 20 normoprolactinemic (NPrl) with prolactinoma; 2) 23 hyperprolactinemic (HPrl) with prolactinoma; 3) 28 controls without prolactinoma or alterations in prolactin levels. Evaluated through anthropometric, dietetics, and biochemical assessment.**

Results: **of the 71 patients evaluated, most were obese women with macroprolactinomas. All three groups had diets with low caloric and monounsaturated fatty acid (MUFA) intake, the NPrl group had low carbohydrate (CHO) intake and high lipid (LIP) and saturated fatty acid (SFA) intake, and the NPrl and HPrl groups had appropriate intake of polyunsaturated fatty acids (PUFA). The HPrl group had elevated total cholesterol. HDL cholesterol was below the recommended threshold for most patients. No statistically significant differences were found in anthropometric and biochemical variables among the groups.**

Conclusions: **most patients with prolactinomas and controls are obese and metabolically similar regardless of prolactin levels. All groups presented low caloric and MUFA intake. Protein, LIP, SFA, and cholesterol were significantly different among the groups, the NPrl group ingested less amount of protein and greater of fat. Snac-**

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EVALUACIÓN NUTRICIONAL Y METABÓLICA EN PACIENTES CON SOBREPESO CON Y SIN HIPERPROLACTINEMIA CAUSADA POR PROLACTINOMA

Resumen

Introducción: **los prolactinomas son adenomas hipofisarios que expresan y secretan prolactina. Estos pacientes tienen sobrepeso y el mecanismo está en estudio.**

Objetivos: **evaluar el estado nutricional y metabólico de los pacientes con sobrepeso con y sin hiperprolactinemia causada por prolactinoma y compararlos.**

Materiales y métodos: **es un estudio transversal con pacientes con índice de masa corporal (IMC) ≥ 25 kg/m² con y sin prolactinoma: 1) 20 normoprolactinémicos (NPrl) con prolactinoma; 2) 23 hiperprolactinémicos (HPrl) con prolactinoma; 3) 28 controles sin prolactinoma o alteraciones en los niveles de prolactina. Evaluados a través de estudios antropométricos evaluación dietética y bioquímica.**

Resultados: **de los 71 pacientes evaluados, la mayoría eran mujeres obesas con macroprolactinomas. Los tres grupos tenían dietas con baja ingesta de calorías y ácidos grasos monoinsaturados (MUFA), el grupo NPrl tenía ingesta baja en carbohidratos (CHO) y alta en lípidos (LIP) y ácidos grasos saturados (SFA), y los grupos NPrl y HPrl tenían ingesta apropiada de ácidos grasos poliinsaturados (PUFA). El grupo HPrl tenía el colesterol sérico por encima del valor recomendado, mientras el colesterol HDL estaba por debajo del valor recomendado en la mayoría de los pacientes. No se encontraron diferencias estadísticamente significativas en las variables antropométricas y bioquímicas entre los grupos.**

Conclusiones: **la mayoría de los pacientes con prolactinomas y los controles son obesos y metabólicamente similares, independientemente de los niveles de prolactina. Todos los grupos presentaron baja ingesta de calorías y de ácidos grasos monoinsaturados. Proteínas, LIP, SFA y colesterol fueron significativamente diferentes entre los grupos, el grupo de NPrl ingiere menos cantidad de proteína y mayor de grasa. La mayoría de los pacientes**

king between meals and changes of food consumption on weekends was reported by most patients. This is the first study comparing patients with prolactinomas and controls, both with overweight, regarding food consumption and feeding behavior.

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Key words: *Prolactinoma. Hyperprolactinemia. Overweight. Obesity. Nutritional assessment.*

manifiestan picar entre las comidas y cambios en el consumo de alimentos los fines de semana. Este es el primer estudio que compara a pacientes con prolactinomas y controles, ambos con sobrepeso, en cuanto a consumo de alimentos y comportamiento alimentario.

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Palabras clave: *Prolactinoma. Hiperprolactinemia. Sobrepeso. Obesidad. Evaluación nutricional.*

Abbreviations

ANOVA: analysis of variance.
BMI: Body mass index.
CHO: carbohydrate.
CVD: cardiovascular disease.
DA: dopamine agonists.
DM: diabetes mellitus.
HBP: high blood pressure.
HC: hip circumference.
HPrl: hyperprolactinemic.
INA: National Dietary Inquiry.
ISCMPA: Irmandade Santa Casa de Misericórdia de Porto Alegre.
LIP: Lipid.
MUFA: monounsaturated fatty acid.
NPrl: normoprolactinemic.
Prl: Prolactin.
PTN: proteins.
PUFA: polyunsaturated fatty acids.
SFA: saturated fatty acid.
SUS: Federal Healthcare System.
WC: Waist circumference.
WHO: World Health Organization.
WHR: waist-to-hip ratio.
24hR: 24-hour diet recall.

Introduction

Prolactin (Prl) is a hormone secreted by the lactotroph cells of the anterior pituitary and its main role is in reproduction and lactation, performing other functions, some related to metabolism[1]. Hyperprolactinemia corresponds to Prl levels above the normal limits and may have physiological (gestation, lactation), pharmacological (antipsychotic or antidepressant use), or pathological (prolactinomas, hypothalamic tumors) causes[2].

Prolactinomas are pituitary adenomas that express and secrete prolactin and have an estimated prevalence of 60-100 cases per million inhabitants, 70% of which among women[3]. Besides the tumor mass and hypogonadism effects, weight gain is one of the symptoms these patients have[1].

Obesity is a multifactorial disease characterized by the accumulation of body fat that occurs due to an imbalance in energy intake, production, and expenditure[4]. Patients with prolactinomas experience body weight increase and a higher prevalence of obesity (35% to 80%) compared to other pituitary adenomas and the overall populaiton[5,6,7,8]. Although the causes of weight gain and metabolic alterations in these patients have not been elucidated, several mechanisms have been researched.

This study aims to assess the nutritional status (nutritional, dietetic, and anthropometric profiles) and metabolic status of overweight and obese patients with and without hyperprolactinemia caused by prolactinoma and to compare them.

Methods

A prospective cross-sectional study was carried out with patients under follow-up at the Endocrinology Outpatient Clinic of Irmandade Santa Casa de Misericórdia de Porto Alegre (ISCMPA) between May 2013 and May 2014. The convenience sample comprised 71 patients above 18 years old of both sexes with body mass index (BMI) ≥25 kg/m^2 with and without hyperprolactinemia, who were assigned to three groups: 1) 20 normoprolactinemic (NPrl) patients with prolactinoma; 2) 23 hyperprolactinemic (HPrl) patients with prolactinoma; and 3) 28 patients normoprolactinemic without prolactinoma (controls).

Patients with Prl levels above 100 ng/dL and imaging exam (MRI or CT scan) with lesion suggestive of adenoma, being lesions <1 cm microprolactinomas and ≥1 cm macroprolactinomas were considered bearers of prolactinomas. Prolactin values within the threshold were considered normoprolactinemia, while hyperprolactinemia values were above 17.7 ng/mL for men; 29.2 ng/mL for women; and 20.3 ng/mL for postmenopausal women.

Patients with hyperprolactinemia due to other causes than prolactinoma and those under nutritional intervention or obesity medications were excluded. The subjects were included after signing a term of free and informed consent. This research was approved by the ethics commissions of the institutions.

The subjects were assigned to the groups and submitted to clinical and nutritional anamnesis, anthropometric, dietary, and biochemical assessments.

The patients were evaluated using a structured questionnaire on personal and behavioral characteristics and comorbidities. Patients with prolactinoma were classified regarding tumor size, Prl levels, time of diagnosis, previous treatments, and current use of dopamine agonists (DA).

Weight and height were measured using an antropometric scale Welmy®, standing upright, barefoot and with light clothes. The BMI was calculated as current weight (kg)/height^2 (m) and classified according to the World Health Organization (WHO)[9]. Waist circumference (WC) was measured around the abdominal region at the medial point between the iliac crest and the lower costal margin using a flexible non-elastic measuring tape with the subject standing after exhaling. The hip circumference (HC) was measured around the hip at its largest diameter with the measuring tape over the greater trochanters and the waist-to-hip ratio (WHR) was calculated. The measures were classified according to the WHO[10].

In order to assess the dietary intake, the 24-hour diet recall (24hR) was used. In order to better estimate portions, images of the different portion sizes were shown[11]. The software DietWinPlus® was used to calculate the nutrients and the cut-off points were based on guidelines[12,13].

The laboratory tests were collected in the morning after 12 h of fasting using the following cut-off points: triglycerides (<150 mg/dL), total cholesterol (<200 mg/dL), HDL cholesterol (men >40 mg/dL; women >50 mg/dL), LDL cholesterol (<130 mg/dL), fasting blood glucose (70 to 99 mg/dL), prolactin (men 2.1 to 17.7 ng/mL; women 2.8 to 29.2 ng/mL; postmenopausal women 1.8 to 20.3 ng/mL), TSH (0.55 to 4.78 μUI/mL), and free T4 (0.7 to 2.0 ng/dL). The quantitative data were described as mean and standard deviation and, in the presence of asymmetry, median and interquartile amplitude. Intragroup comparisons used analysis of variance (ANOVA) and Student's t-test was used if intragroup differences were found. Categorical data were compared using the Chi-squared and Fisher's exact test at 5% significance level. The data were analyzed using the software SPSS version 21.0 beta.

Results

Initially, 78 patients were assessed, of whom three with prolactinoma and four without were excluded, thus 71 patients were included in the study. Among the NPrl subjects, 13 (65%) were women and seven (35%) were men, with mean age of 47.7±16.4 years. Among the HPrl subjects, 18 (78.3%) were women and five (21.7%) were men, with mean age of 48.3±16.12 years. Among the controls, 20 (71.4%) were women and eight (28.6%) were men, with mean age of 48.9±14.8 years. There was a predominance of the white race in 80%, 78.3% and 78.3% in groups NPrl, HPrl, and controls, respectively. There was a predominance of macroprolactinomas, 70% of the NPrl and 73% of HPrl.

DA use was similar between NPrl (60%) and HPrl (56.5%). Surgery was performed for tumor resection in 25% of the NPrl and 43.5% of the HPrl patients. Radiotherapy was used as adjuvant therapy in 15% of the NPrl subjects. The time of diagnosis in the NPrl and HPrl patients was 60 (24-141) and 84 (36-240) months, respectively. The Prl in the NPrl and HPrl was 9.0 (3.8-11.0) and 58.5 (35.2-89.2) ng/mL, respectively. The current use of AD was 70% in HPrl and 47.8% in NPrl patients, being the use of cabergoline and bromocriptine similar between the groups.

Regarding lifestyle, most subjects were non-smokers, did not consume alcohol, and over 80% did not practice physical activity regularly. The most common comorbidities were diabetes mellitus (DM), high blood pressure (HBP), and cardiovascular disease (CVD), more frequent in controls as shown in table I.

Table II shows the anthropometric assessment. The mean BMI in the NPrl group was 32.6±6.1 kg/m^2 and 55% were obese. In the HPrl group, the mean BMI was 35.0±7.3 km/m^2 and 78.2% were obese. Mean BMI among controls was 34.3±5.7 kg/m^2 and 78.6% were obese.

WC values were very high in 70% of the NPrl subjects, in 91.3% of the HPrl, and in 82.1% of the controls. The mean WHR was high in all groups. The biochemical assessment is described in table II. Evaluating the three groups in relation to lipid profile, total cholesterol was above the recommended limit only among the HPrl subjects. HDL cholesterol was below the recommended limit in more than 50% of both men and women in all three groups. In relation to anthropometric and biochemical variables, there were no statistically significant differences between the three groups.

Calorie and nutrient intakes are shown in table III. The intake of proteins (PTN), lipids (LIP), saturated fatty acids (SFA), and cholesterol were significantly different among the three groups, the NPrl group ingested less amount of PTN and greater of fat. The carbohydrate (CHO) intake was below the recommended level in NPrl patients and controls. PTN intake was adequate for all groups. Regarding fat intake, LIP and SFA were slightly above the recommended levels in the NPrl group, monounsaturated fatty acids (MUFA) were below the recommended in all groups, polyunsaturated fatty acids (PUFA) were within the recommendation among the NPrl and HPrl subjects, and cholesterol intake was adequate in all three groups. Only the controls reached the minimum recommended intake of fibers.

Dietary behavior characteristics are detailed in table IV. The average number of meals per day in the NPrl group was 4.2±0.8; in the HPrl, 3.7±0.6; and in the controls, 4.0±1.1. Over 95% of the subjects used vegetable oil to prepare food, with a monthly per capita intake of 964.4±620.8 mL for the NPrl, 813.2±510.4 mL for the HPrl, and 626.0±355.5 mL for the controls. Olive oil was used by 10% of the NPrl and controls

Table I
Behavioral characteristics and health status of patients with and without hyperprolactinemia caused by prolactinomas (n=71)

Variables	*NPrl (n=20) n (%)*	*HPrl (n=23) n (%)*	*Controls (n=28) n (%)*
Smoking			
Smoker	2 (10)	2 (8.7)	4 (14.3)
Never smoked	14 (70)	13 (56.5)	19 (67.9)
Former smoker	4 (20)	8 (34.8)	5 (17.9)
Alcohol consumption*			
Yes	4 (20)	4 (17.4)	2 (7.1)
No	16 (80)	19 (82.6)	26 (92.9)
Physical exercise**			
Practices	3 (15)	3 (13)	5 (17.9)
Does not practice	17 (85)	20 (87)	23 (82.1)
Diabetes mellitus			
Yes	4 (20)	3 (13)	12 (42.9)
No	16 (80)	20 (87)	16 (57.1)
High blood pressure			
Yes	9 (45)	9 (39.1)	18 (64.3)
No	11 (55)	14 (60.9)	10 (35.7)
Cardiovascular disease			
Yes	1 (5)	3 (13)	6 (21.4)
No	19 (95)	20 (87)	22 (78.6)

NPrl: normoprolactinemic; HPrl: hyperprolactinemic; n: sample number; %: relative frequency; *: yes for at least 1 dose per week; **: practices >150 minutes per week.

Table II
Values of anthropometric measures and biochemical tests of patients with and without hyperprolactinemia caused by prolactinomas (n=71)

Variables	*NPrl (mean±SD)*	*HPrl (mean±SD)*	*Controls (mean±SD)*
Weight (kg)	86.9±22.0	89.4±19.1	87.8±16.1
BMI (kg/m^2)	32.5±6.1	35.0±7.3	34.3±5.7
HC (cm)	105.1±19.4	107.9±13.0	105.8±12.7
HC (cm)	109.0±10.3	113.6±14.5	112.1±11.2
WHR	0.96±0.13	0.95±0.06	0.94±0.09
Total cholesterol (mg/dL)	188.7±40.9	207.9±41.4	187.0±48.9
LDL cholesterol (mg/dL)	114.9±40.7	128.4± 40.3	110.9±40.9
HDL cholesterol (mg/dL)	46.5±14.4	51.3±17.1	46.6±13.6
Triglycerides (mg/dL)	146.8±61.6	142.4±64.5	149.9±64.6
Glucose (mg/dL)	100.9±38.6	88.4±19.4	113.8±49.3

NPrl: normoprolactinemic; HPrl: hyperprolactinemic; SD: standard deviation; BMI: body mass index; WC: waist circumference; HC: hip circumference; WHR: waist-to-hip ratio.

and by less than 5% of the HPrl. Bacon, lard, margarine, and butter were also used by 30% of the NPrl subjects, 21.7% of the HPrl, and 25% of the controls. The consumption of apparent SFA in meats (beef and poultry) was 38% in the NPrl group and 42% in the HPrl and controls.

When NPrl+HPrl subjects were compared to controls, glucose was higher among the controls (p=0.04). However, when the patients with DM were excluded from the analysis, this difference did not remain (p=0.32). When HPrl subject were compared to NPrl+controls, no statistically significant difference was found among the

Table III
Dietary intake characteristics of patients with and without hyperprolactinemia caused by prolactinomas (n=71)

Nutrients	*NPrl (mean±SD)*	*HPrl (mean±SD)*	*Controls (mean±SD)*	*Recommended**
Calories (kcal)	1,609.5±568.0	1,504.5±447.7	1,478.0±408.4	**
Carbohydrates (%tcv)	50.4±9.0	57.2±7.6	52.2±11.5	55-60%
Proteins (%tcv)***	17.0±4.6	17.4±5.0	20.1±4.8	15-20%
Lipids (%tcv)***	32.5±7.9	25.2±6.8	27.5±10.6	20-30%
SFA (%tcv) ***	10.6±3.3	8.5±2.7	9.0±3.3	<10%
MUFA (%tcv)	8.8±4.7	8.0±4.1	7.4±4.6	15-20%
PUFA (%tcv)	5.9±3.2	5.1±3.0	4.8±3.0	5-10%
Cholesterol(mg) ***	268.5±145.2	165.7±86.0	203.9±96.9	<300 mg/day
Fibers (g)	18.1±9.2	18.1±11.4	20.4±8.7	20-30 g/day

NPrl: normoprolactinemic; HPrl: hyperprolactinemic; SD: standard deviation; *: ABESO[12]; Santos et a.l[13]; **: according to current weight; %tcv: percentage of the total caloric value; SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; ***: p<0,05

Table IV
Dietary behavior characteristics of patients with and without hyperprolactinemia caused by prolactinomas (n=71)

Variables	*NPrl n (%)*	*HPrl n (%)*	*Controls n (%)*
Habit of snacking along the day			
Yes	13 (65)	14 (60.9)	16 (57.1)
No	7 (35)	9 (39.1)	12 (42.9)
Habit of snacking at night			
Yes	3 (15)	6 (26.1)	6 (21.4)
No	17 (85)	17 (73.9)	22 (78.6)
Dietary intake change on the weekend			
Yes	19 (95)	21 (91.3)	23 (82.1)
No	1 (5)	2 (8.7)	5 (17.9)
Reason of dietary intake change on the weekend			
Time availability	2 (10)	0	1 (3.6)
Environment/family	7 (35)	10 (43.5)	13 (46.4)
Both	9 (45)	11 (47.8)	8 (28.6)
Others	0	0	1 (3.6)
Does not know/not applicable	2 (10)	2 (8.7)	5 (17.8)
Type of sweetener used			
Refined sugar	14 (70)	18 (78.3)	12 (42.9)
Brown sugar	1 (5)	0	1 (3.6)
Artificial sweetener	4 (20)	3 (13.0)	9 (32.1)
None	1 (5)	2 (8.7)	6 (21.4)

NPrl: normoprolactinemic; HPrl: hyperprolactinemic; n: sample number; %: relative frequency.

groups, but HPrl had a tendency for high total cholesterol levels (p=0.07).

Discussion

This study presents demographic, nutritional, and biochemical characteristics of patients with and without prolactinoma and overweight. The prolactinoma represents over 45% of pituitary tumors, being more frequent in women, in more than 70% of cases[3]. A study by Malik *et al.*[14] assessed 68 patients with prolactinoma, 63.2% of whom women, and macroprolactinomas were the most common (52.9%), followed by microprolactinomas (33.8%) and giant prolactinomas (13.3%). Doknic *et al.*[15] studied 23 patients with prolactinoma, being 65.2% macroprolactinomas and 34.8% microprolactinomas. Women were the majority

of the sample in the present study too. The most prevalent tumor type was macroprolactinoma. This sample was well defined and consistent and matched, in sampling terms, other studies in the literature.

The initial treatment of prolactinomas is medication with dopamine agonists (DA). Surgery and radiotherapy are used when there is failure with the medication[2]. Greenman *et al*.[5], when studying 42 patients with prolactinoma, described DA use in 88.1%, surgery in 23.8%, and radiation therapy in 4.8%. In a study by Malik *et al*.[14], 97.1% used DA, 22.1% underwent surgery, and 1.5% received radiotherapy. The present data match those described in the literature. The differences in treatment among studies can be attributed to differences in tumor size in the samples as well as to changes in the therapy choices of prolactinomas in recent years. While 70% of the NPrl patients used DA during the study and were normoprolactinemic, nearly half of the HPrl patients used DA and were hyperprolactinemic, possibly due to irregular medication use.

The practice of physical activity in Brazil has increased significantly since 2009. According to data by VIGITEL[16], 35.3% of Brazilians practice physical activity for at least 150 minutes per week, although this rate drops to 22.9% among those with up to eight years of education. In the present sample, among the three groups studied, less than 20% of the patients practiced physical activity, possibly due to the sample's characteristics: Patients who attend the outpatient clinic of the Federal Healthcare System (SUS), come from the interior of the state and have low schooling and low income level. Subjects in the NPrl and HPrl groups had similar smoking rates compared to those in VIGITEL[16], i.e., 10.8% smoking prevalence in the Brazilian population. The prevalence in the control group, however, was higher.

The prevalence of overweight and obesity is rising worldwide according to the WHO[4]: 39% of adults are overweight and 13% are obese. In Brazil[16], 52.5% of the population is overweight and a third of those are obese, 17.9% of the overall population. The literature has described overweight among patients with prolactinoma and different mechanisms of this weight gain have been discussed: reduced dopaminergic tonus, lipogenesis stimulation, reduction in adiponectin levels, leptin resistance, increased hypothalamic pressure, and hypogonadism[5,6,17].

Santos-Silva *et al*.[7] assessed 22 patients with prolactinoma, 45% of whom obese and 27% overweight. Barbosa *et al*.[17] found similar data, 48.6% obese and 20% overweight. A study by Pereira-Lima *et al*.[8] found 50% of obesity among macroprolactinomas and 30% among microprolactinomas. The prevalence of obesity among patients with prolactinoma is higher than among patients with other pituitary adenomas. Schmid *et al*.[6], studying 399 adenomas, found obesity in 35% of prolactinomas, in 22.2% of adrenocorticotropinomas, in 21.4% of somatotropinomas, and in 17% of clinically non-functioning adenomas. Assunção Alves Rodrigues *et al*.[18] reported obesity in 15% of the normoprolactinemic and in 40% of the hyperprolactinemic patients with prolactinomas. The present study found a high prevalence of obesity among patients with prolactinoma, i.e., 55% of the NPrl and 78.2% of the HPrl.

Santos-Silva *et al*.[7], Assunção Alves Rodrigues *et al*.[18], and Cirese *et al*.[19] found BMI within the overweight range in both normoprolactinemic and hyperprolactinemic patients. Naliato *et al*.[20] found BMI in the eutrophia range among normoprolactinemics and in the overweight range among hyperprolactinemics, with a significant difference between the groups. The present study found mean BMI in the range of obesity grade I in the NPrl group and obesity grade II in the HPrl.

Santos-Silva *et al*.[7], Barbosa *et al*.[17], and Cirese *et al*.[19] reported normal WC values for normoprolactinemic and hyperprolactinemic patients. Assunção Alves Rodrigues *et al*.[18] and Berinder *et al*.[21] reported normal WHR for normoprolactinemic patients of both sexes and for hyperprolactinemic women, however, the values were high for hyperprolactinemic men. WC and WHR values in the present sample were above the normal threshold, which shows a large abdominal fat accumulation and high CVD risk among these individuals. The present data of BMI, WC, and WHR are higher than those described in the literature, since the sample comprises exclusively overweight and obese patients, with a predominance of the latter.

Regarding the lipid profile, most studies with prolactinomas describe normal serum levels both for normoprolactinemics and hyperprolactinemics[7,18,22]. The present study also found normal serum lipid levels, except for total cholesterol, which was slightly high for HPrl patients, data similar to that found by Berinder *et al*.[21] The glucose levels described for prolactinoma patients are also normal[19,23]. In the present study, glucose levels were slightly high for NPrl and adequate for HPrl patients.

Regarding comparative studies between HPrl prolactinomas and controls, Serri *et al*.[23] and Tuczu *et al*.[24] found no statistically significant difference in values of WC, total cholesterol, triglycerides, LDL cholesterol, HDL cholesterol, or glucose. Naliato *et al*.[20], when comparing 31 non-obese women with prolactinoma to 21 controls without prolactinoma, found no statistically significant difference in BMI and WC values. Jiang *et al*.[25] compared HPrl prolactinomas to controls and found significantly higher values for the variables WC, BMI, triglycerides, and glucose in the hyperprolactinemic subjects, with a positive correlation among prolactin, triglycerides, and glucose.

Assunção Alves Rodrigues *et al*.[18] compared 20 NPrl prolactinomas to 20 HPrl prolactinomas and 40 controls. The WC, HDL cholesterol, and triglyceride values were significantly higher among the HPrl subjects than the NPrl and controls. The present study

found no statistically significant difference in the anthropometric and biochemical variables studied between patients with prolactinomas (NPrl+HPrl) and controls or between HPrl patients and normoprolactinemic subjects (NPrl+controls), demonstrating how the three populations studied, once overweight, are metabolically similar, regardless of prolactinomas or high levels of prolactin.

In relation to food consumption, the Brazilian dietary standard has changed over the last few decades with an increase of the intake of industrialized foods rich in SFA, sodium, and sugar, which is associated with weight gain and higher CVD risk[26]. Data of the 2008-2009 National Dietary Inquiry (*Inquérito Nacional de Alimentação* – INA)[27], estimated by means of two dietary records on non-consecutive days, showed that Brazilians consume an average of 1,902±608 kcal, 56±7% CHO, 17±3% PTN, 27±5% LIP, 9±2% SFA, 6±1% PUFA, 9±2% MUFA, 253±127 mg cholesterol, and 20±9 g fiber. In a study carried out in the Brazilian state of Rio Grande do Sul, the average consumption of macronutrients of obese candidates to bariatric surgery was 2,782.7±1,131.4 kcal, 51.2% CHO, 16.4% PTN, and 29.6% LIP[28].

The intake of calories in all groups of the present sample was lower than the average of the Brazilian population and of obese persons in southern Brazil. Given the mean calorie intake (1,530.7 kcal) and mean weight (88 kg) in the three groups, the caloric density of the energy consumption would be 17.4 kcal/kg weight, with represents a hypocaloric diet that does not match the sample's anthropometric profile. The investigation method employed, one-day 24hR, has limitations on the food consumption findings. The low calorie intake found could also be due to underreporting. Overweight and obese persons omit the consumption of snacks and desserts, the meal frequency, and portion sizes, which could lead to underreporting of 30% to 50% of the total caloric value, particularly among women[29]. In order to minimize these limitations, it was decided to use the data of feeding behavior.

The number and frequency of daily meals contribute to obesity and metabolic syndrome. Marín-Guerrero *et al*.[30], when studying dietary behaviors, found that persons who had only two meals a day had a higher prevalence of obesity compared to those who had three or four meals a day, irrespective of sex. The habit of snacking between meals was associated with obesity among women since it leads to a higher intake of calories and SFA[30]. The present study found an average of four meals a day. The snacking between meals (57.1-65%) and changes of food consumption on weekends (82.1-95%) was reported by most patients.

The intake of macro- and micronutrients found in the sample was similar to that found in INA[27], except for the intake of lipids and SFA, with higher levels among the NPrl subjects. It is known that excessive SFA intake, mainly foodstuffs of animal origin, contributes to higher LDL cholesterol and CVD risk[13].

Regarding the intake of visible fat in beef and poultry, data from the last VIGITEL[16] reported intake by 29.4% of Brazilians, while a study carried out in southern Brazil 52.3% reported consuming this type of fat[31]. In the present study, approximately 40% reported consuming visible fat in beef and poultry, while 21.7% to 30% reported consuming bacon, lard, and butter, which confirms these are frequent habits among the population in our region.

MUFA intake did not reach the recommended minimum in any of the groups studied, which is also true for the Brazilian population[27]. Olive oil, a source of MUFA, was used by a low percentage of patients in all three groups. The benefits of consuming these fatty acids include CVD risk reduction and the replacement of SFA by MUFA improves sensitivity to insulin, reducing the risk of DM[13].

The Ministry of Health[32] recommends the intake of 225 mL of vegetable oils per person per month, i.e., a standard 900 mL oil can should be the amount used by a family of four over one month. Moreira *et al*.[33], while studying the feeding behavior of 131 women in the Brazilian state of Minas Gerais, found that the monthly per capita oil intake was 556 mL. The monthly per capita consumption of vegetable oil found in our study (626 to 964 mL) reflects overuse in the preparation of meals, with a predominance of fried foods.

The intake of added sugar, i.e., not naturally present in foods, has been associated with higher risk of chronic diseases such as obesity, CVD, DM, and tooth cavities[34]. The WHO[34] recommends that this intake does not exceed 10% of the total calories in the diet. Data from the INA show that the Brazilian population consumes an average of 13% of calories from sugar[27]. The use of refined sugar added to beverages was 70% in the NPrl group, 78.3% in the HPrl, and 42.9% among controls, a habit that is highly prevalent in the population studied.

Conclusion

Regardless of the prolactin levels, most patients with prolactinoma NPrl and HPrl, are obese and metabolically similar when compared to each other and to controls. Low calorie and MUFA intake was found in all the groups. NPrl and HPrl patients had appropriate PUFA intake. Protein, lipids, SFA, and cholesterol were significantly different among the groups, the NPrl group ingested less amount of PTN and greater of fat. The snacking between meals and changes of food consumption on weekends was reported by most patients.

This is the first study comparing patients with prolactinomas and controls, both with overweight, regarding food consumption and feeding behavior. The follow-up of these patients, as well as their responses to nutritional intervention, will bring new information to this relevant subject.

Author Disclosure Statement

The authors have no conflicts of interest to declare.

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